

use of smaller HEPA filters allows smaller ports for maintenance. Filter changes should be planned for times when other maintenance operations (routine or special) are taking place inside the box to reduce interruptions to operations, to reduce the loss of inert gas, and to minimize the time required to recondition box spaces.

For fire protection, the preventive step of inerting is more satisfactory, though more expensive, than extinguishing a fire if it does occur. However, oxygen must be reduced below 1 percent before it fails to support the burning of some pyrophoric metal.<sup>9</sup> The use of dry air (relative humidity less than 20 percent) reduces the hazard of pyrophoric metal fires, but does not eliminate it. Moisture in the presence of heated pyrophoric or reactive metals, such as finely divided plutonium, increases the possibility of explosion by generating hydrogen. The suitability and cost of an inert gas for the process are significant factors when selecting this type of fire control. The gas flow rate in most inert gas boxes is kept as low as possible to be consistent with required box-atmosphere purity levels; low-capacity filters are frequently used. The inert gas may be purged on a once-through basis or recirculated through a purification unit. A word of caution concerning commercially available (off-the-shelf) recirculating gloveboxes: on one occasion at one DOE installation, there was a problem with oil mists developing in the recirculating pumps and being circulated along with the inert gas. Off-the-shelf items cannot be used in a containment-type ventilation system without evaluation, nor can they be applied as "black boxes" by those responsible for operational safety.

## **10.7 OPERATIONS AND MAINTENANCE PRACTICES FOR FIRE PROTECTION OF CONFINEMENT VENTILATION SYSTEMS**

### **10.7.1 ESSENTIAL ELEMENTS**

The protection of confinement ventilation systems during a fire situation depends on the reliable functioning of the procedures, systems, and barriers as they were designed and intended to function. To retain that design capability it is

critical that maintenance and surveillance of systems be accomplished on an established schedule. Procedures must be practiced. And systems must be regularly inspected to locate problems that may require alteration of the maintenance practices and operational procedures. If these aspects are not accomplished, the ability of the confinement ventilation system to function when needed may be impaired.

#### **10.7.1.1 FIRE PREVENTION**

The first step in establishing the ability of a confinement ventilation system to function during a fire is, of course, to either avoid having a fire or practice fire prevention. For the purposes of nuclear facilities with confinement ventilation systems, the most critical aspect of fire prevention is fuel control. The storage of any extraneous combustible materials in filter enclosures or areas where radioactive materials are being handled must be prohibited.

Procedures for the use of flammable liquids and gases must be in place and be followed. Quantities of flammable liquids and gases must be limited to only those required to perform any task.

Accumulation of dust and debris inside the confinement ventilation system ductwork over long periods of operation increases the consequences of any fires that might occur. Periodic cleaning is required to eliminate the presence of undesired fuel.

Appropriate procedures and controls must be in place and followed to prevent fire involving pyrophoric radioactive materials. Much experience exists on the start of fires in nuclear facilities and confinement ventilation systems.<sup>64</sup> The lessons of the past should be applied to prevent fire from occurring in confinement ventilation systems, or where a fire occurs, a loss of the first line of defense.

#### **10.7.1.2 PROCEDURES**

Procedures for safe operation of the facility must exist. All hazards and necessary controls must be delineated in existing operational procedures. The procedures must complement the facility safety documentation that is required by law or contractual obligations.

### **10.7.1.3 INSPECTION, TESTING, AND MAINTENANCE**

Inspection, testing, and maintenance requirements for fire detection and suppression systems are outlined in the NFPA standards. A program should exist that follows either the NFPA standards or a carefully thought-out alternative program that provides an equivalent degree of reliability.

All systems in the facility and its confinement ventilation system, both passive and active, must have inspection, testing, and maintenance plans that have been established and implemented.

Limited Life Materials that will wear out in a relatively short time in all systems should be identified and replaced according to an established plan.

### **10.7.1.4 IMPAIRMENT PLANNING**

A program must exist to handle situations where fire detection and suppression systems are impaired. Pre-plans must be developed and instituted to guide facility operations when these systems are not functioning as they should. Impairment plans also must exist for other critical facility systems. The occurrence of an impairment is not the time to develop such plans. All impairment plans must be analyzed to identify and control to the greatest possible extent the hazards that may exist under a given condition.

Impairment plans should be exercised on a regular basis to maintain proficiency in their execution.

### **10.7.1.5 MODIFICATIONS**

Modifications in a nuclear facility must follow the protocols for Unreviewed Safety Question determination. This is a somewhat roundabout means of identifying the impact to the established safety basis and all that goes with that, but it is what the current culture understands and accepts. Configuration control must be maintained when modifications are made so that all changes are tracked across all affected documentation and all impacts are identified and understood.

### **10.7.1.6 EMERGENCY PLANNING**

The successful mitigation of a fire in a nuclear facility containing a confinement ventilation

system requires emergency planning and exercises involving all entities that may be called on to mitigate a fire situation. Post-fire recovery plans should exist to aid in the resumption of work in the facility after a fire.

### **10.7.1.7 TECHNICAL SAFETY REQUIREMENTS TIE-IN**

Maintenance and operational procedures may be formalized in the nuclear facility's Technical Safety Requirements.

### **10.7.1.8 QUALITY ASSURANCE**

All aspects of operations should be tied in to the facility Quality Assurance Program, which covers all of the areas required to produce quality work and to operate safely.

### **10.7.1.9 ASSESSMENTS**

Periodic management and independent assessment are necessary to ensure that established requirements are adequate and are properly implemented.

## **10.8 GENERIC FIREFIGHTING PROCEDURES**

The following recommendations apply to firefighting procedures and instructions. They provide a strategy that minimizes the likelihood of losing filtered, forced ventilation during a fire. These procedures were derived from extensive work at Rocky Flats and are included here because they are generically applicable to all DOE facilities where active fire protection measures are installed for filter plenum protection.

A special need for nuclear facilities with confinement ventilation systems is smoke venting. Obviously, smoke cannot be vented to the exterior, but there may be methods to use the confinement ventilation system to assist in removing some smoke from the fire area to enable more rapid intervention in manual suppression of the fire.

### **10.8.1 CONTROL VENTILATION CONFIGURATIONS, VOLUMES, AND FLOW RATES IN THE FIELD**

An individual who is responsible for ventilation control (and successors or alternates in case of unavailability) must be established in the facility